21. Baum RA, Carpenter JP, Golden MA, Velazquez OC, Clark TW, Stavropoulous SW, et al. Treatment of type 2 endoleaks after endovascular repair of abdominal aortic aneurysms: comparison of transarterial and translumbar techniques. J Vasc Surg 2002;35:23-9.
22. Martin ML, Dolmatch BL, Fry PD, Machan LS. Treatment of type II endoleaks with Onyx. J Vasc Interv Radiol 2001;12:629-32.
23. Schmid R, Gurke L, Aschwanden M, Stierli P, Jacob AL. CT-guided percutaneous embolization of a lumbar artery maintaining a type II endoleak. J Endovasc Ther 2002;9:198-202.
24. Kasirajan K, Matteson B, Marek JM, Langsfeld M. Technique and results of transfemoral superselective coil embolization of type II lumbar endoleak. J Vasc Surg 2003;38:61-6.
25. Haulon S, Tyazi A, Willoteaux S, Koussa M, Lions C, Beregi JP. Embolization of type II endoleaks after aortic stent-graft implantation: technique and immediate results. J Vasc Surg 2001;34:600-5.
26. Karch LA, Henretta JP, Hodgson KJ, Mattos MA, Ramsey DE, McLafferty RB, et al. Algorithm for the diagnosis and treatment of endoleaks. Am J Surg 1999;178:225-31.
27. Chuter TA, Faruqi RM, Sawhney R, Reilly LM, Kerlan RB, Canto CJ, et al. Endoleak after endovascular repair of abdominal aortic aneurysm. J Vasc Surg 2001;34:98-105.

Submitted Feb 14, 2007; accepted Apr 3, 2007.

INVITED COMMENTARY

Jeffrey P. Carpenter, MD, *Philadelphia, Pa*

Rupture of aneurysms after endovascular aneurysm repair (EVAR) happens at an alarming rate of 1% per year according to both European Collaborators on Stent-Graft Techniques for AAA and Thoracic Aortic Aneurysm and Dissection Repair (EUROSTAR) and Lifeline Registry data. Continued, careful monitoring of patients after EVAR is essential and clearly mandated by this sobering statistic. How to do so, however, remains problematic. Repeated contrast exposure (and radiation exposure) is detrimental, as evidenced by the more precipitous decline in renal function noted in EVAR cohorts compared with open surgical aneurysm repair cohorts. Duplex scanning as an alternative method of monitoring patients for endoleak has performed well in the hands of some, but not all.

Direct puncture of aneurysm sacs has allowed us to directly access endoleaks, ascertain their significance, and treat them. By this method we have learned that even seemingly small and innocuous type II endoleaks may transmit systemic pressure to the aneurysm wall, placing patients at risk for fatal rupture of their aneurysm. This invasive method, however, is not practical as a screening or monitoring test.

Continuous measurement of pressure within the aneurysm sac by means of implanted remote pressure sensors has been proposed as another alternative method of monitoring patients after EVAR. This technique is attractive in that it gets to the "bottom line," the measurement of pressure within the sac itself. One of the challenges to this technology, however, is the phenomenon of differential distributions of pressure spread throughout the thrombus-filled aneurysm sac. This observation has been made in animal models of aortic aneurysms and now directly in human subjects.

Pressure sensor technology is in its infancy. In addition to malfunctions of the sensors, false-negative study results have been reported. The report of Dias et al raises further concerns about the a priori ability of a pressure sensor to accurately detect an endoleak unless it is in direct communication with that leak. Sensors located within the thrombus will suffer progressive dampening in proportion to their distance from the endoleak and may fail to detect a leak that could be transmitting significant pressure to the aneurysm wall elsewhere. The future of pressure sensor technology for EVAR monitoring is as yet unclear, and a long-term observational trial has yet to be performed. The differential distribution of pressures within a thrombus filled aneurysm sac will need to be an important consideration in the future development of this technology.